

the Coal-measure and Cretaceous shells before mentioned have been, even the most massive *Unios* would doubtless be found with as thin a shell as *Myalina* and *Inoceramus* now possess.

Mr. F. B. Meek's investigations have shown that the prismatic structure is a very common (if not a constant) character of the fossil *Aviculidæ*; and it is doubtless of much value as a family character; but since it is also seen in certain genera of *Mytilidæ* and the *Naiades*, it is known that it is not the peculiar property of any family.—*Silliman's American Journal*, May 1868.

Smelts breeding in an Aquarium.

Mr. Brightwell, passing through the Norwich fish-market the other day, had his attention called by a man to his aquarium, in which he found some smelts, caught in the river, were kept alive. They had deposited spawn on the stones at the bottom; and the young fry had emerged, so exceedingly minute as scarcely to be seen, but distinguishable as young smelts. They make excellent microscopical objects.—L. B.

On the Formation of Coral Reefs. By CARL SEMPER.

The well-known annular form of the reefs containing lagoons, the *atolls*, was formerly explained by supposing that the polypes had built their dwellings, perpendicularly upwards, upon the margins of the craters of submarine volcanos, by which an external ring (an outer reef) must necessarily be produced, closing the crater, now become a lake, against the outer sea. In this, however, the allied forms of the *barrier reefs* (that is to say, such as fringe elevated islands lying in the sea) and the *coast reefs* occurring in all tropical seas were not taken into consideration. Darwin, by his theory, brought the three forms into mutual connexion. He thought he could demonstrate that the atolls and barrier reefs could only be explained by the assumption of the gradual *sinking* of a continent or island, and the coast reefs by an *elevation* of the shores. Although he himself called attention to some difficulties, he believed he could support the value of his theory in opposition to such obstinate facts, especially by demonstrating how in general the *coast reefs* were formed only on shores now in course of elevation, the *atolls* and *barrier reefs*, on the contrary, in regions of the sea in which the want of all active volcanic energy indicates a depression.

Nevertheless cases do occur which cannot be explained thus. Leaving out of consideration the Philippines, where several atolls are found in the midst of islands in course of elevation, the western Caroline Islands, the Pelew Islands, furnish a very striking example of an association of extreme forms. At the north of the chain of islands (which stretches nearly north and south, and is about sixty geographical miles in length), there are true atolls; in the middle,

barrier reefs surrounding volcanic islands, and passing gradually towards the south into coast reefs, which are closely applied to coral reefs elevated to as much as 200 feet. The group of islands terminates in a small island entirely destitute of reefs, separated from the rest by a channel four geographical miles in breadth. If we were to apply Darwin's theory to this example, we should have to regard this southernmost island as a resting point, whilst the northern part, by sinking, had rendered the formation of atolls possible. Independent of the improbability that a mountain-chain ascending from the deep sea at a distance from all other insular groups, and having so small a horizontal extension (sixty miles in length by six to seven miles in breadth), should possess so great a difference of vertical movement, facts directly observed testify against a depression, nay, even render it probable that an elevation has taken place in recent times. The northern volcanic islands are formed by two different basaltic eruptions, one of which bears the present and the older elevated reefs of the south, whilst the second partially overlies them. Traces of a trachytic eruption also occur, but, apparently, isolated from the larger basaltic island. These islands, therefore, belong to a comparatively very recent geological period. And the elevated coral reefs of the south, partly converted into dense coralline limestone, in other places decomposed into chalk, pass directly over into the existing reefs. A depression is further disproved by the nature of the submarine surface in the interior of the lagoon-channel. Whilst in the north there is a deep and often very broad channel which separates the outer reef from the shore of the island, the numerous small elevated coralline limestone islands of the south are united by a surface extending for many miles nearly horizontally scarcely 4-6 fathoms beneath the surface of the sea, and which, in still water at the time of the spring tides, may be traced out of the sea into the supramarine rocks and islands. A horizontal surface attaining such colossal dimensions could not possibly be formed during a depression which, a few miles further north, had produced a channel of 70 fathoms in depth.

The author rather regards the physical influences, especially the internal sea-currents caused by the rain, and the exterior direct and diverted ones, as the causes which have produced in the north the atolls, and in the south the coast reefs, simultaneously with an elevation. Whilst in the latter the deep-going eroding action of the wave-blow or the wash of the sea has gradually planed away the dense and solid coralline limestone to a nearly horizontal surface, which lies at about the depth to which the sea-wash is capable of acting, in the north the becks coming down from the mountains, conjointly with the wash and currents of the sea, have acted much more strongly upon the uncommonly soft, readily decomposable basalt of the west, than was the case with the limestone in the south, and have eaten out the deep lagoon-channels, which in particular places extend to the width of a mile between the solid ground and the outer reef.—*Verhandl. der phys.-med. Gesellsch. in Würzburg*, February 1, 1868.